

**REMARKS**

Claims 1 through 3, 6 through 20, 23 through 31, 34 through 37 and 39 through 41 are currently pending in the application.

All claims stand rejected.

Applicant have amended claims 1 through 3, 6 through 20, 23 through 31, 34 through 37 and 39 through 41 to replace all occurrences of the word “said” with “the.” Applicant have drafted new independent claim 42.

Applicant respectfully request reconsideration.

**35 U.S.C. § 112 Claim Rejections**

Claims 1 through 3, 6 through 20, 23 through 31, 34 through 37 and 39 through 41 are rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicant regards as the invention.

The Examiner states that the term “slightly heated” in claims 1, 18, and 29 is a relative term which renders the claims indefinite. Applicant asserts that the specification provides a sufficient standard for ascertaining the requisite degree of heating and that one of ordinary skill in the art would be reasonably apprised of the scope of the invention. The words cited by the examiner are found in the phrase “...transferring the solder paste when slightly heated to the secondary substrate” (from the cavity). Therefore, one of skill in the art would understand that the slight heating refers to the heating required to transfer the solder paste from the cavity to the second carrier substrate.

The as-filed specification states that “[o]nce the solder paste 24 is applied to surface 12 of substrate mold 10, the entire assembly is heated to a temperature sufficient enough to slightly melt the metal solder paste in order to begin formation of the solder bumps to be transferred.” (As-Filed Specification, page 9 line 28 - page 10 line 1). “The assembly of the substrate mold 10 and carrier substrate 28 is heated to a sufficient enough temperature to cause solder bumps 26 to slightly reflow and release from the release layer 20 formed on substrate mold 10.” (As-Filed Specification, page 10 lines 5-7).

It is also disclosed that various types of metal solder may be used. Several different alloys are disclosed in the as-filed specification on page 9 at lines 21-27. One skilled in the art would recognize that the degree of heating necessary to cause the bumps to slightly reflow and release from the release layer would depend on the metal or alloy used as the solder material. One skilled in the art would also recognize that the temperature necessary to cause the bumps to slightly reflow for any given metal or alloy would be proximate to the melting temperature of the alloy, or at least proximate to the melting temperature of a phase in a multiphase alloy. These values are readily available in engineering and metallurgical handbooks for the metal or alloy used for the solder paste.

For these reasons, Applicant asserts that claims 1, 18, and 29 clearly complies with the provisions of 35 U.S.C. § 112, first paragraph, and that the specification does provide a standard for ascertaining the requisite degree of heating, and request that the rejection be withdrawn.

Applicant additionally asserts that dependent claims 2, 3, 6 through 17, 19, 20, 23 through 28, 30, 31, 34 through 37, and 39 through 41 also comply with the provisions of 35 U.S.C. § 112, first paragraph as they depend either directly or indirectly from claims 1, 18, and 29.

### **35 U.S.C. § 103(a) Rejections**

Obviousness Rejection Based on Ochiai et al. (U.S. Patent 5,643,831) in view of any one of Yeh et al. (U.S. Patent No. 5,607,099), Cordes et al. (U.S. Patent 6,105,852), Tusji et al. (U.S. Patent 5,930,603), MacKay et al. (U.S. Patent 6,293,456) and Fallon et al. (U.S. Patent 5,872,051)

Claims 1 through 3, 6 through 11, 16 through 20, 23 through 31, 34 through 37 and 41 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Ochiai et al. (U.S. Patent 5,643,831) in view of any one of Yeh et al. (U.S. Patent No. 5,607,099), Cordes et al. (U.S. Patent 6,105,852), Tusji et al. (U.S. Patent 5,930,603), MacKay et al. (U.S. Patent 6,293,456) and Fallon et al. (U.S. Patent No. 5,872,051). Applicant respectfully traverses this rejection, as hereinafter set forth.

Applicant submits that to establish a *prima facie* case of obviousness under 35 U.S.C. § 103 three basic criteria must be met. First, there must be some suggestion or motivation, either

in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Third, the cited prior art reference must teach or suggest all of the claim limitations. Furthermore, the suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on Applicant's disclosure.

Applicant maintains the position set forth in previous communications with the Examiner and reaffirms and incorporates herein all arguments made in the Amendment dated February 18<sup>th</sup>, 2004 at pages 8 through 15.

Applicant submits that any combination of the cited prior art fails to establish a *prima facie* case of obviousness under 35 U.S.C. § 103 because there is no suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify or combine the teachings of the references cited by the Examiner. In particular, there is no modification to modify or combine the teachings of the references because the modification or combination proposed by the Examiner would change the principle of operation of the invention of Ochiai et al.

Applicant assert that the principle of operation of the invention of Ochiai et al. is to form cavities having a mouth in the shape of a rhombus and a wedge-shaped bottom in a mold such that when solder paste is placed in the cavities and heated sufficiently to form solder balls therein, the solder balls have a diameter and rest in a particular position within the cavities such that a portion of the solder ball is disposed above the surface of the mold as shown in FIGS. 1C, 1D, and 3. *See* Ochiai et al., column 5 lines 11-24. This allows a member onto which solder bumps are to be formed to be moved toward the solder balls that are disposed within the cavities and partially projecting therefrom until the member abuts the solder balls (but not the mold surface), and the solder balls are transferred from the mold cavity to the member. Ochiai et al., column 5 lines 25-31, FIGS. 1C-1E.

Applicant assert that if cavities having shapes other than a wedge, such as those taught by Yeh et al. (square or rectangular shaped cavities as viewed from above, trapezoidal shaped cavities as viewed in cross section), Cordes et al. (hemispherical cavities), Tsuji et al.

(hemispherical cavities), MacKay et al. (square or trapezoidal shaped cavities as viewed from above, square or rectangular cavities as viewed in cross section), and Fallon et al. (rectangular or trapezoidal shaped cavities as viewed in cross section, square shaped as viewed from above) were used in the invention disclosed by Ochiai et al., the solder balls formed therein would not “sufficiently project” from the flat surface of the solder ball forming plate and the solder balls may not be positioned in “identical positions” in each of the cavities. *See* Ochiai et al., column 5 lines 11-24. Therefore, applicant respectfully asserts that the proposed modification would change the principle of operation of the Ochiai et al. invention.

The Office Action asserts that it would have been obvious to physically incorporate “conventional mold shapes” into the solder ball forming plate of Ochiai et al “since a skilled artisan would have expected the mold apparatus of Ochiai et al. ‘831 to perform equally well with the mold cavities having any such conventional mold cavity shapes.” Office Action mailed March 11, 2004, page 4. Applicant respectfully disagrees with this assertion. As discussed previously, solder balls formed in cavities having shapes other than wedge-shapes, such as those disclosed in the references cited in the Office Action, would not, in all likelihood, “sufficiently project” from the flat surface of the solder ball forming plate and may not be positioned in “identical positions” in each of the cavities. Therefore, the solder ball forming plate of Ochiai et al. having conventional mold cavity shapes therein clearly would not have been considered by one skilled in the art to “perform equally [as] well” as the plate wedge-shaped cavities therein as disclosed and taught in Ochiai et al. Applicant additionally submits that “recognized utility for forming solder balls” is not a sufficient motivation to combine or modify references as to render the combination or modification obvious under 35 U.S.C. 103.

In addition, Applicant submits that any combination of the cited prior art fails to establish a *prima facie* case of obviousness under 35 U.S.C. § 103 because one skilled in the art of the invention would have no reasonable expectation of success in forming the presently claimed invention by combining or modifying the references cited in the Office Action. In particular, the teachings of Ochiai et al. teach away from combining the invention therein with the cavity shapes disclosed in Yeh et al., Tsuji et al., MacKay et al., and Fallon et al.

As discussed above, it is disclosed and taught in Ochiai et al. that the cavities have a “mouth in the shape of a rhombus, and a wedge-shaped bottom” so that the solder balls formed therein will “sufficiently project from the flat surface of the solder ball forming plate” and will be formed “in the identical positions in the cavities.” *See* Ochiai et al., column 4 lines 52-56, column 5 lines 11-24, and column 6 lines 38-41. Applicant assert that solder balls formed in other cavities having shapes other than a wedge, such as those disclosed in the references cited in the Office Action, would not, in all likelihood, “sufficiently project” from the flat surface of the solder ball forming plate and may not be positioned in “identical positions” in each of the cavities. Therefore, Ochiai et al. teach away from combining or modifying the cited references because one skilled in the art would recognize that the geometries disclosed in the references would not serve the purposes for which the wedge-shaped geometry was selected by Ochiai et al.

Applicant additionally assert, as they have done in previous communications, that it would, in all likelihood, be impossible to form the cavity shapes disclosed in Yeh et al., Cordes et al., Tsuji et al., MacKay et al., and Fallon et al. into the solder ball forming plate of Ochiai et al. because the crystallographic plane that forms the surface in which the cavities are formed, together with the orientation of the mask relative to the surface, determines in large part the shape of the resulting cavity.

Ochiai et al. disclose and teach that the “silicon wafer is cut so that the flat surface is in a  $\langle 110 \rangle$  crystallographic plane, and the orientation flat L1 is in a  $\langle 1-11 \rangle$  crystallographic plane.” *E.g.*, Ochiai et al., column 6 lines 13-17. In addition, “[t]he apertures of the mask are formed in the shape of rhombus, having sides L2 and L3, arranged such that side L2 of the rhombus is generally parallel to the  $\langle 1-11 \rangle$  crystallographic plane....” Ochiai et al., column 6 lines 23-28. “This arrangement allows the formation of the cavities each having a mouth in the shape of a rhombus, and a wedge-shaped bottom, upon subsequent etching.” Ochiai et al., column 6 lines 28-31. Applicant asserts that for these reasons, it would have been obvious to one skilled in the art that it would have been impossible to incorporate the cavity shapes disclosed in Yeh et al., Cordes et al., Tsuji et al., MacKay et al., and Fallon et al. into the solder ball forming plate of Ochiai et al.

Applicant concedes that “the test for obviousness is not whether the features of a secondary reference may be bodily incorporated into the structure of the primary reference....” In re Keller, 642 F.2d 413, 425 (CCPA 1981). However, Applicant asserts that when it would have been obvious to one skilled in the art that the features or teachings were not physically combinable, *it strongly teaches away* from combining the teachings of the references and weighs in favor of a finding of a lack of a reasonable expectation of success. When one skilled in the art readily perceives that features or teachings are not physically combinable, subsequent thought, research, or inquiry in regards to their combination is hindered and may make the combination non-obvious. If it were not readily perceived that the teachings or features were not physically combinable, inquiry into their combination would not be hindered and, therefore, the fact that they are not physically combinable may not render the combination non-obvious. Applicant asserts that it would have been obvious to one skilled in the art of the invention that it would be impossible to physically incorporate the cavity shapes disclosed in Yeh et al., Cordes et al., Tsuji et al., MacKay et al., and Fallon et al. into the solder ball forming plate of Ochiai et al. Therefore, the disclosure of Ochiai et al. teaches away from combining the cited references.

Applicant notes that even if one could physically incorporate the cavity shapes disclosed in Yeh et al., Cordes et al., Tsuji et al., MacKay et al., and Fallon et al. into the solder ball forming plate of Ochiai et al., the mere fact that references can be combined or modified does not render the resultant combination obvious unless the prior art also suggests the desirability of the combination. In re Mills, 916 F.2d 680 (Fed. Cir. 1990). Applicant respectfully asserts that none of the references cited in the Office Action suggest the desirability of combining the cavity shapes disclosed in Yeh et al., Cordes et al., Tsuji et al., MacKay et al., and Fallon et al. into the solder ball forming plate of Ochiai et al.

For these reasons, in addition to the reasons set forth in previous communications with the Examiner, Applicant asserts that the inventions of claims 1, 18, and 29 are allowable over any combination of Ochiai et al. in view of any one of Yeh et al., Cordes et al., Tsuji et al., MacKay et al. and Fallon et al. under 35 U.S.C. § 103 because any combination of the cited prior art fails to establish a *prima facie* case of obviousness regarding the claimed inventions.

Applicant additionally asserts that any combination of the cited prior art also does not establish a *prima facie* case of obviousness under 35 U.S.C. § 103 regarding the claimed inventions the inventions of dependent claims 2, 3, 6 through 11, 16, 17, 19, 20, 23 through 28, 30, 31, 34 through 37 and 41 since they depend either directly or indirectly from one of claims 1, 18, and 19.

Applicant also asserts that none of the cited references teach or disclose a “release layer hav[ing] a thickness ranging from about 200 Angstroms to 5 micrometers,” as recited in claim 7, and that it would not have been obvious to modify any of the inventions of the cited references to provide a release layer having a thickness ranging from about 200 Angstroms to 5 micrometers. Applicant therefore request that the rejection of claim 7 under 35 U.S.C. 103(a) be withdrawn for this additional reason.

Applicant also asserts that none of the cited references teach or disclose a “substrate compris[ing] ceramic material,” as recited in claim 17, and that it would not have been obvious to modify any of the inventions of the cited references to provide a substrate comprising a ceramic material. Applicant therefore request that the rejection of claim 17 under 35 U.S.C. 103(a) be withdrawn for this additional reason.

Obviousness Rejection Based on Ochiai et al. (U.S. Patent 5,643,831) in view of any one of Yeh et al. (U.S. Patent 5,607,099), Cordes et al. (U.S. Patent 6,105,852), Tusji et al. (U.S. Patent 5,930,603), MacKay et al. (U.S. Patent 6,293,456) and Fallon et al. (U.S. Patent 5,872,051) as applied to claims 1-3, 6-11, 16-20, 23-31, 34-37 and 41 in paragraph 5 above, and further in view of Bolstad (U.S. Patent 2,979,773)

Claims 12 through 15, 39, and 40 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Ochiai et al. (U.S. Patent 5,643,831) in view of any one of Yeh et al. (U.S. Patent 5,607,099), Cordes et al. (U.S. Patent 6,105,852), Tusji et al. (U.S. Patent 5,930,603), MacKay et al. (U.S. Patent 6,293,456) and Fallon et al. (U.S. Patent 5,872,051) as applied to claims 1-3, 6-11, 16-20, 23-31, 34-37 and 41 in paragraph 5 above, and further in view of Bolstad (U.S. Patent 2,979,773).

Again, Applicant further submits that to establish a *prima facie* case of obviousness under 35 U.S.C. § 103 three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Third, the cited prior art reference must teach or suggest all of the claim limitations. Furthermore, the suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on Applicant's disclosure.

Applicant maintains the position set forth in previous communications with the Examiner and reaffirms and incorporates herein all arguments made in the Amendment dated February 18<sup>th</sup>, 2004 at pages 15-17.

Applicant additionally asserts that the limitation "at least one heating strip located on another surface of the substrate" of the mold apparatus of either of claims 1 or 29 is not disclosed or taught in any of the references cited in the Office Action. Applicant asserts that Bolstad does not "disclose [or teach or suggest] heater strips for efficiently providing heat to a semiconductor mold material," as maintained in the Office Action. Such is not a fair reading of Bolstad.

Bolstad teaches or suggests an apparatus for molding plastic bodies utilizing thermoplastic resins comprising a mold body 14 having a mold cavity 19 that is lined with a thin film of a semiconducting material. "A suitable conductive electrode is placed on the surface of the semiconductive film and is ...provided with a suitable electrical lead for passing an electrical current *through the semiconductive film.*" Bolstad, column 3 lines 2-6 (emphasis added). "The other electrical contact is made to the body of the mold through any suitable connection...." Bolstad, column 3 lines 26-29. In this configuration, "current is ...passed *through the semiconductive film....*" Bolstad, column 3 lines 35-36 (emphasis added). "[T]he surface portion only of the mold cavity 19 experiences [a] rise in temperature *provided by the semiconductive film.*" Bolstad, column 3 lines 37-39 (emphasis added).

In sum, Bolstad discloses and teaches that a current can be passed through a semiconductive film, the electrical resistance in the semiconductive film generating heat used to



heat the cavity of a thermoplastic mold. At best, Bolstad teaches or suggests providing a heating film comprising semiconducting material on a thermoplastic mold.

In the present invention, the mold is not a thermoplastic mold for molding plastic bodies. It is a very tiny substrate (relative to conventional thermoplastic molds) having cavities formed therein for forming discrete bodies of solder paste. It is taught in the present invention that the mold substrate can be formed from *semiconductor* materials, such as silicon. One benefit of such materials is that they can be used to easily manufacture the very small mold substrate with precise dimensions. These *semiconductor* materials that form the mold substrate are not used to conduct electricity and generate heat, as are the *semiconducting* films of Bolstad. To heat the *semiconductor* materials of the instant invention, it is taught that the substrate mold may include “heating strips located on the bottom thereof for the heating of the substrate mold with [an] electrical conductor connected thereto. The bottom surface of the substrate mold includes a coating thereon *to electrically insulate the heating strips from the substrate mold.*” As-Filed Specification, page 13 lines 9-12 (emphasis added). Thus, no current passes through the *semiconductor* materials of the instant invention.

If the instant invention were to incorporate the disclosures and teachings of Bolstad, a *semiconducting* film, such as *doped* silicon, would have to line the cavities of the substrate mold. In addition, electrical contacts would have to be applied to the *semiconducting* film to allow current to be passed therethrough to generate resistance heat. The instant invention does not teach or disclose such an embodiment. Combining the teachings and disclosures of Bolstad with those of Ochaia et al. does not produce the instant invention. Therefore it clearly cannot be maintained that Bolstad teaches or discloses the limitation “at least one heating strip located on another surface of the substrate” of the mold apparatus of either of claims 1 or 29.

In addition, Applicant asserts that none of the cited references, including Bolstad, teach or disclose “a plurality of heating strips,” as recited in claims 13 and 40.

For each of the above reasons, Applicant asserts that the inventions of claims 12 through 15, 39, and 40 are allowable because any combination of Ochiai et al. in view of any one of Yeh et al., Cordes et al., Tusji et al., MacKay et al. and Fallon et al., and further in view of Bolstad

does not establish a establish a *prima facie* case of obviousness regarding the claimed inventions under 35 U.S.C. § 103.

### CONCLUSION

Claims 1 through 3, 6 through 20, 23 through 31, 34 through 37 and 39 through 42 are believed to be in condition for allowance, and an early notice thereof is respectfully solicited. Should the Office determine that additional issues remain which might be resolved by a telephone conference, the Examiner is respectfully invited to contact Applicant's undersigned attorney.

Respectfully submitted,



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